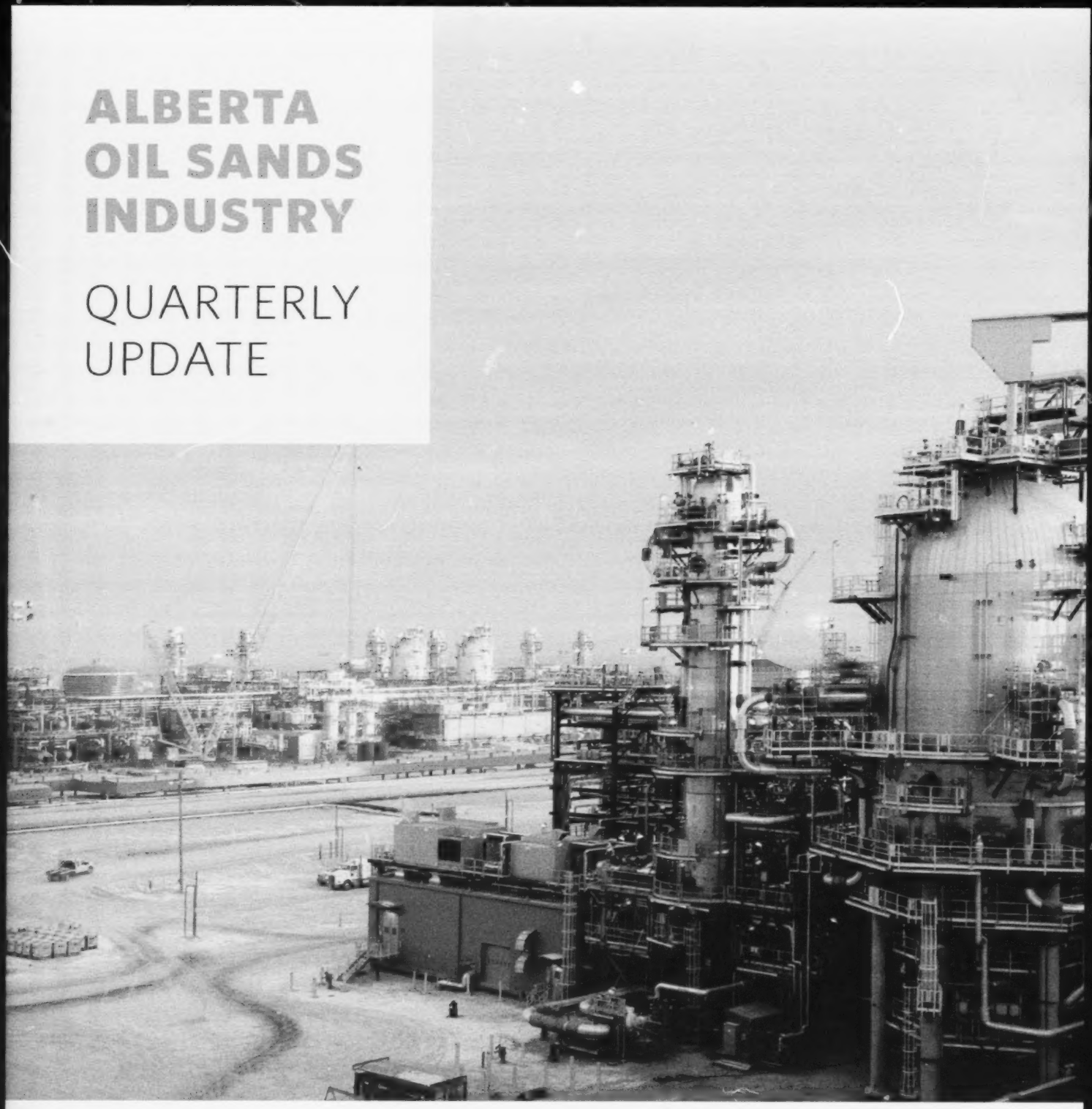
ALBERTA OIL SANDS INDUSTRY

QUARTERLY UPDATE



SPRING 2017

Reporting period:
DECEMBER 5, 2016,
TO MARCH 20, 2017

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3 Market update
5 Resource + technology spotlight

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7 Business
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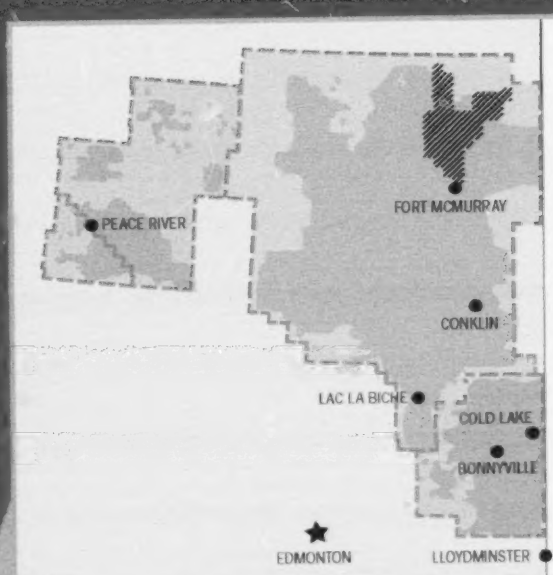
ALBERTA'S OIL SANDS

Canada's oil sands resources exist in three major deposits in Alberta: Athabasca, Cold Lake and Peace River. Athabasca, the largest in size and resource, is home to the surface mineable region. All other bitumen must be produced in situ or by drilling. Currently, the vast majority of oil sands production is exported to U.S. markets.



Initial volume in place
1.84 trillion barrels

Initial established reserves
176.8 billion barrels

Remaining established reserves (2016)
165.4 billion barrels

Cumulative production (2016)
11.4 billion barrels

Kitimat
Peace River
Fort McMurray
Grande Prairie
Edmonton
Burnaby
Hardisty
Anacortes
Calgary
Cromer
Clearbrook
Superior
Quebec City
Saint John
Montreal
Guernsey
Sarnia
Flanagan
Chicago
Patoka
Wood River
Cushing
Houston
Port Arthur
Freeport

Oil sands deposit
Peace River
Athabasca
Cold Lake
Surface mineable area
Oil sands area
Capital of Alberta
Pipeline
Proposed Pipeline

Canadian and U.S. crude oil pipelines and proposals

1. Enbridge Gateway
2. Kinder Morgan Trans Mountain
3. TransCanada Keystone
4. Spectra Express - Platte System
5. TransCanada Keystone XL
6. ENB Spearhead South
   ENB Flanagan South
7. ENB/Enterprise Seaway
8. TransCanada Gulf Coast Extension
9. Enbridge Mainline
10. TransCanada Energy East
11. Enbridge Line 9
12. Enbridge Southern Access

MARKET UPDATE

ALBERTA ENERGY REGULATOR 2016 OIL SANDS REVIEW

2016 was another challenging year for hydrocarbon producers in Alberta. Faced with continued low global crude oil prices and weak natural gas prices, Alberta producers sought additional cost savings and curtailed capital budgets and activity. Additionally, wildfires in the area of Fort McMurray disrupted oil sands production in May, with impacts lasting into summer.

However, some positive news also emerged in 2016. The Government of Canada approved two major crude oil pipeline projects: the twinning of the Kinder Morgan Trans Mountain Pipeline to Canada's west coast and the replacement of the Enbridge Line 3 Pipeline to the U.S. Midwest. These projects, if completed, will increase Alberta's export capacity, and the Trans Mountain Pipeline will open up market access to Asia.

Further good news was the agreement by OPEC and several major oil-producing nonmember countries to lower crude oil production. The impact on crude oil prices, however, will depend on the level of compliance and whether U.S. shale production growth offsets any achieved reductions.

CAPITAL SPENDING

The Alberta Energy Regulator (AER) forecasts that oil sands capital expenditures will decrease from an estimated $16 billion in 2016 to $14.2 billion in 2017, reflecting the continued deferral of projects and successful implementation of cost reduction strategies. Capital expenditures in the oil sands are projected to be primarily focused on sustaining capital, debottlenecking and expanding existing projects.

The AER expects that capital spending in 2018 will be C$14.3 billion but will moderate further, averaging about $12 billion per year between 2019 and 2026. This incorporates the assumption that the successful deployment of cost reduction strategies and use of new technologies will improve efficiencies and that capital outlays will focus on sustaining capital, expanding existing projects, namely in mining and upgrading, and the addition of small to moderate-sized in situ schemes over the forecast period.

TECHNOLOGY TO ENABLE GROWTH

New technologies can make greenfield SAGD projects in a US$50/bbl WTI world, enabling the oil sands industry to compete more effectively on the global stage, says a recent report from CIBC Institutional Equity Research.

This could be enabled by a combination of incremental new technologies, game changers and systems that fit somewhere in between.

"The goal for oil sands producers today is to lower supply costs and improve environmental stewardship while supporting oil sands development," CIBC analysts write.

"These goals will be achieved by a spectrum of applications, ranging from simply better ways of doing things with less steel and fewer energy inputs to radically new recovery schemes."

First up is what CIBC refers to as "streamlined projects," which include smaller central processing facilities and sustaining well pads with less metal, fewer valves, less instrumentation and greater automation.

Analysts write that streamlined projects could lower supply costs to US$58/bbl from US$65 to US$70 today.

Next in line are projects that use hybrid steam/solvent processes, which are expected to lower supply costs to US$57/bbl, before accounting for the benefit of streamlining technologies. CIBC estimates that hybrid solvent/steam projects are commercially achievable within two to three years, primarily due to the time it would take to construct a project.

The AER forecasts that oil sands capital spending will drop to $14.2 billion in 2017, from $16 billion in 2016.

Solvent-only projects, like the Nsolv system that is currently being piloted at Suncor's Dover site, are next on CIBC's spectrum.

"This technology has the potential to lower supply costs to below US$50/bbl," analysts write, estimating commercialization in five to six years.

On the further end of the spectrum are hybrid electromagnetic heat/solvent processes, like the electromagnetically assisted solvent extraction (EASE) system that is also being tested at Dover.

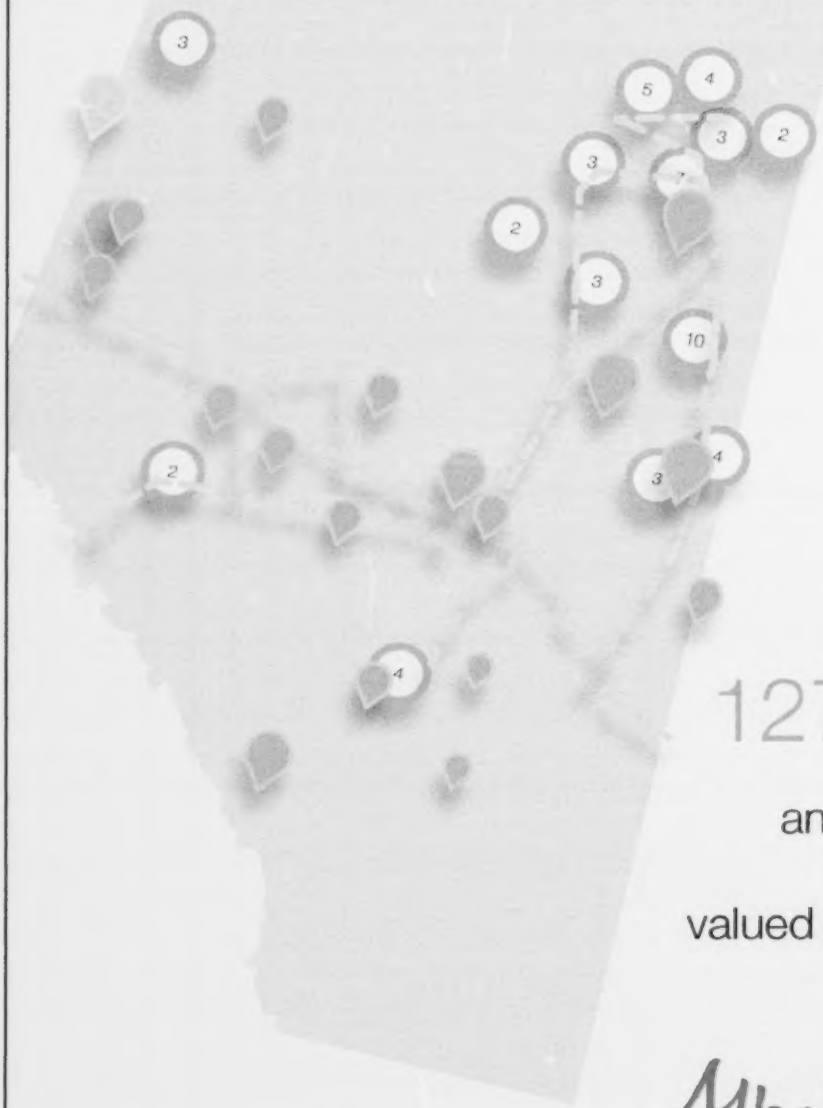
While CIBC expects the supply cost for an EASE project to be closer to US$65/bbl, analysts expect the technology would significantly decrease sustaining capex and greenhouse gas emissions.

On the whole, CIBC says "our analysis suggests that in the next five years, greenfield oil sands development will be able to earn a 15 per cent rate of return in a US$50/bbl oil world, and that Alberta's emission cap may not hinder development in the next decade as conventional thinking believes, both of which point to the belief that the oil sands (and not just higher quality oil sands) will not necessarily be a stranded resource." ■

majorprojects.alberta.ca

ALBERTA MAJOR PROJECTS

An inventory of private and public sector projects in Alberta valued at $5 million or greater

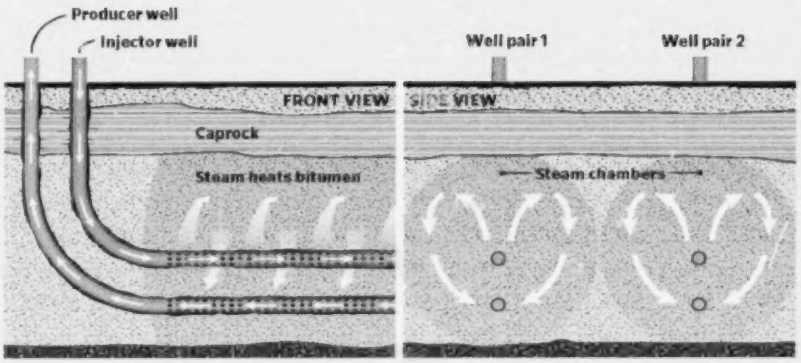


127 oil & gas, pipeline and industrial projects valued at $176.9B

Alberta Government

RESOURCE + TECHNOLOGY SPOTLIGHT

STEAM ASSISTED GRAVITY DRAINAGE (SAGD)



BACKGROUND

In Alberta, 80 per cent of oil sands reserves (about 135 billion barrels) are buried too deep below the surface for open pit mining and can only be accessed through in situ methods. "In situ" is Latin for "in place."

While being too deep for open pit mining, large amounts of in situ oil sands resources are also too shallow for the higher-pressure technology that has been in commercial use for decades, cyclic steam stimulation (CSS).

Recognizing the opportunity, in the 1980s the Alberta Oil Sands Technology and Research Authority invested public funds to build the Underground Test Facility north of Fort McMurray, where an Imperial Oil chemical engineer named Roger Butler's concept of steam assisted gravity drainage (SAGD) was tested.

Because the technology relies on horizontal wells and surface horizontal drilling was not yet commercial, the test wells were drilled from a limestone formation beneath the bitumen deposit. The system worked, and advances in horizontal drilling enabled projects drilled from the surface and a step-change in oil sands production.

The first SAGD project achieved commerciality in 2001, and since that time, the technology has swept across the industry.

HOW IT WORKS

With the SAGD technique, a pair of horizontal wells, one situated four to six metres above the other, is drilled from a central well pad. In a plant nearby, water is transformed into steam, which then travels through above-ground pipelines to the wells and enters the ground via the steam injection (top) well.

The steam heats the heavy oil to a temperature at which it can flow by gravity into the producing (bottom) well. The steam injection and oil production happen continuously and simultaneously.

The resulting oil and condensed steam emulsion is then piped from the producing well to the plant, where it is separated and treated. The water is recycled for generating new steam.

WHERE IT WORKS/CURRENT STATUS

The vast majority of Alberta's SAGD production comes from the Athabasca oil sands deposit, particularly in the region south of Fort McMurray. In January 2017, there were 11 SAGD projects operating south of Fort McMurray that collectively produced about 800,000 bbls/d, according to the Alberta Energy Regulator.

North of Fort McMurray there were four SAGD projects that together produced about 275,000 bbls/d, and in the Cold Lake region there were three SAGD projects that produced a collective 45,000 bbls/d.

In January 2017, SAGD accounted for 81 per cent of Alberta's in situ oil sands production, with the remainder of volumes produced via CSS.

Overall, SAGD technology is responsible for about 40 per cent of Alberta oil sands production, while mining operations produce about 52 per cent.

COMPANIES THAT USE SAGD

The companies that operate SAGD production in Alberta are Cenovus Energy, Suncor Energy, Devon Canada, ConocoPhillips Canada, MEG Energy, Canadian Natural Resources, Husky Energy, CNOOC Nexen, Pengrowth Energy, Connacher Oil and Gas, Athabasca Oil, Osum Oil Sands, Sunshine Oilsands and BlackPearl Resources.

THE FUTURE

Alberta's oil sands producers are developing technologies to make new SAGD projects competitive with other oil plays, including U.S. shale development, in terms of both costs and environmental footprint as the price of oil remains low.

This will be enabled by a combination of incremental new technologies, game changers and systems that fit somewhere in between, noted CIBC Equity Research in early 2017.

"The goal for oil sands producers today is to lower supply costs and improve environmental stewardship while supporting oil sands development," CIBC analysts wrote.

"These goals will be achieved by a spectrum of applications, ranging from simply better ways of doing things with less steel and fewer energy inputs to radically new recovery schemes."

Offering particular potential are systems that either co-inject solvents with steam or inject solvent alone, offering dramatic reductions in water use, greenhouse gas emissions, capital and operating costs. ■

WHAT'S NEW
PROJECTS

Suncor has initiated the regulatory process for a new SAGD project by issuing the proposed terms of reference for its environmental impact assessment.

The proposed Meadow Creek West project, which would have capacity of 40,000 bbls/d, is located south of Fort McMurray near the Hangingstone SAGD projects owned by Japan Canada Oil Sands and Athabasca Oil.

Construction on Meadow Creek West is expected to begin in 2022 with first oil expected in 2026.

MEG Energy says successful implementation of its eMSAGP production enhancement system is going to be further applied at the company's Christina Lake oil sands project starting this year to the tune of a 20,000-bbl/d production increase.

EMSAGP employs infill wells and natural gas co-injection, and MEG has used it successfully at its existing Christina Lake SAGD project to improve production rates and reduce costs.

About 55 per cent of MEG's $590-million 2017 capital budget will be put toward eMSAGP growth.

MEG Energy has filed the application for its proposed May River SAGD project with the Alberta Energy Regulator.

The total capital cost over the life of the 164,000-bbl/d project, comprised of two 40,000-bbl/d phases and a third 80,000-bbl/d phase, is $10 billion including sustaining capital expenditures.

MEG says May River would use its eMSAGP technology "where applicable" to improve efficiency.

Construction of the first phase of May River could begin in 2019.

Pengrowth Energy has filed an application with the Alberta Energy Regulator to increase approved nameplate capacity at Lindbergh from 30,000 to 40,000 bbls/d.

The company says the strong performance of Phase 1 has enabled a fourth well pad, a second treater skid and additional cogeneration capacity to be added to Phase 2 of Lindbergh. Pengrowth credits a steam to oil ratio of 2.5:1 with making steam available to be diverted into new wells.

Pengrowth says it anticipates sanctioning Phase 2 in late 2017 or 2018 depending on market conditions.

Husky Energy is seeking approval to increase the capacity of its Sunrise SAGD project to 69,000 bbls/d from the current design capacity of 60,000 bbls/d and to increase its sulphur dioxide emission limit to 1.6 tonnes a day from the currently approved one tonne a day.

Sunrise is not meeting the committed sulphur recovery rate of 95 per cent due to operational challenges with its sulphur recovery unit, the company says.

The SAGD project averaged 25,821 bbls/d in 2016, according to Alberta Energy Regulator data.

Husky predicts that project capacity will grow by optimizing existing infrastructure and operating all 10 once-through steam generators at their full capacity of 100 megawatts.

Cenovus Energy has announced a three-year business outlook that includes the completion of two new SAGD expansions.

Details on the timing and cost estimates for the 30,000-bbl/d Foster Creek Phase H and 45,000-bbl/d Narrows Lake Phase A (a first commercial application of solvent co-injection) will be released in June.

Cenovus also restarted construction of its 40,000-bbl/d Christina Lake Phase G expansion in late 2016 after suspending work in 2014 amid the oil price collapse, and has about 600,000 bbls/d

of SAGD growth already stamped with regulatory approval.

Cenovus expects to produce between 172,000 and 184,000 bbls/d from its oil sands assets in 2017 as production ramps up from the new expansions.

Koch has filed an application with the Alberta Energy Regulator for Selina, a new 12,500-bbl/d SAGD project owned jointly with Pengrowth Energy, located near Pengrowth's high-performing Lindbergh SAGD project.

Koch's application estimates at $512-million capital cost for the project, which is an investment of about $41,000 per flowing barrel. Construction is expected to take place in late 2018.

Japan Canada Oil Sands has filed an application with the Alberta Energy Regulator to restart the Hangingstone SAGD project it suspended last spring due to market conditions.

The company suspended operations at the 6,000-bbl/d project in May 2016, a process that was put in motion before the Fort McMurray wildfires but accelerated due to the regional emergency.

WHAT'S NEW
BUSINESS

Canadian Natural Resources will become the operator of the Athabasca Oil Sands Project (AOSP) and the Scotford Upgrader, following a set of deals with Royal Dutch Shell and Marathon Oil Corporation.

Canadian Natural will hold a 70 per cent stake in the AOSP through the acquisition of Shell's 60 per cent and 10 per cent from Marathon, while Shell will acquire Marathon's remaining 10 per cent and remain the operator of the Scotford Upgrader.

Canadian Natural has also acquired Shell's in situ leases and operating assets in the Peace River region.

The value of the deals to Canadian Natural is $12.74 billion.

The Oil Sands Community Alliance (OSCA) is working with the Regional Municipality of Wood Buffalo (RMWB) to help industry and the community navigate a potentially dramatic taxation shift.

Last spring, the Alberta government announced Bill 21, which includes amendments designed to increase industry competitiveness by linking non-residential and residential tax rates.

15 new oil sands project phases came online between 2015 and the start of 2017.

Under the new rules, the highest non-residential tax rate can be no more than five times the lowest residential tax rate, or a ratio of 5:1, the government says.

This is a big change in the RMWB and Fort McMurray, where the current ratio is 18:1.

OSCA's main focus is to work collaboratively with the RMWB on a response to Bill 21. In November, OSCA and the municipality launched a joint committee that is working on a strategy to get the ratio toward 5:1.

The joint committee with the RMWB will release its Bill 21 response this spring.

U.S. Gulf Coast refineries are looking to process more Canadian heavy oil barrels as supplies drop from OPEC countries, analysts at Raymond James said in a research note issued in early March.

"With the differential between Maya and WCS now below transport costs to the Gulf Coast, our suspicion is that the pullback of heavy oil supplies from OPEC members is resulting in U.S. refineries bidding up Canadian heavy oil barrels in response, leading to the tightening [in the differential]," Raymond James said.

Typically, OPEC countries tend to focus their production cuts on heavier grades, the analysts note, adding that this is a logical approach to maximizing revenue given the lower prices these streams receive. This is in addition to ongoing production declines in heavy oil-focused OPEC countries like Venezuela and Mexico.

While the situation may be positive for Canadian heavy oil producers, Raymond James noted that the tighter spread will put increased pressure on heavy-focused U.S. refining margins and presents downside risk to refinery utilization.

ExxonMobil and ConocoPhillips wrote down a combined 4.65 billion barrels of proved reserves in late February, erasing $183 billion of oil sands assets based on current prices for the Western Canada Select benchmark.

Exxon alone removed the entire $16-billion, 3.5-billion-barrel Kearl oil sands project from its books. Analysts note the write-downs are likely temporary and are a result of strict U.S. Securities and Exchange Commission (SEC) oil price assumptions.

U.S.-listed companies post reserves based on a trailing 12-month-average oil price, while Canadian reserves evaluations are booked according to the *Canadian Oil and Gas Evaluation Handbook*, which uses forward-looking oil price expectations.

ExxonMobil has already said that the current revisions of what qualifies as proved reserves are not expected to affect the operation of the underlying projects or to alter the company's outlook for future production volumes.

Alberta's real GDP is forecast to grow by 2.8 per cent this year, the fastest among the provinces, thanks to expanding oil sands production, says a new report from the Conference Board of Canada.

This is a reflection of oil sands growth projects that were well advanced at the time of the oil price collapse reaching completion.

Fifteen new oil sands project phases came online between 2015 and the start of 2017, adding production capacity of nearly 650,000 bbls/d, according to the *Daily Oil Bulletin*'s Canadian Oilsands Navigator.

This year, another three major projects will come online, including the 194,000-bbl/d Fort Hills mining project, Japan Canada Oil Sands' 20,000-bbl/d Hangingstone expansion and the 50,000-bbl/d Sturgeon Refinery.

WHAT'S NEW

ENVIRONMENT + TECHNOLOGY

A team of researchers led by the University of British Columbia (UBC) is looking at a strain of the bacteria E.coli as a solution to allow oil sands mining companies to discharge process-affected water back into the Athabasca River without harmful environmental consequences.

In a $207,000 research project co-funded by Genome BC and Metabolik Technologies, UBC says an E.coli strain could provide a new bioremediation technique for processing oil sands tailings water as early as 2018.

The strain of E.coli the group is looking to develop can tolerate cold northern climates while rapidly degrading naphthenic acids (NAs). Treatment of NAs in oil sands tailings is particularly difficult because they are quite soluble in water, therefore exposing aquatic life to toxic effects, the researchers say.

Alberta Innovates, leading a consortium that consists of major oil sands producers, has signed a contract with FuelCell Energy for an engineering study on a fuel cell carbon-capture application.

The study will consider applying FuelCell's technology, which was originally developed with a focus on capturing CO_2 from coal-based power generation, at a Husky SAGD facility near Lloydminster and at the Scotford Upgrader near Edmonton.

The study focuses on the ability of a fuel-cell power plant to separate and capture CO_2 from both a SAGD heavy oil thermal facility and a bitumen upgrading facility, efficiently concentrating CO_2 from the extraction process as a side reaction to power generation.

The consortium says the study should be completed by summer 2017.

Vancouver-based BGC Engineering, in partnership with Seattle-based LOOOK,

has developed a proof of concept application based on Microsoft's HoloLens system that they say turns traditional flat engineering drawings and data into interactive 3-D maps and immersive landscapes.

This self-contained holographic computer that users wear on their heads could be particularly valuable when it comes to communicating oil sands reclamation planning, allowing wearers a complete view of a reclaimed environment.

Suncor's integrated operations centre (IOC), a remote control room in downtown Calgary, has resulted in significant savings for the company's Firebag SAGD project.

Based on the offshore operations model, the system has resulted in a significant drop in on-site staff and contributed to a 35 per cent decrease in per-barrel cash costs and a 34 per cent increase in production rates since 2013, says senior reservoir engineer Richard Chan.

The IOC "requires less human intervention," Chan told a session hosted in December by the Canadian Heavy Oil Association. Fewer people on site also offer improved productivity because of fewer distractions and enhanced safety with reduced travel times.

Nsolv has completed the optimization phase of its pilot project, which is proving to be "robust and reliable while achieving all performance indicators," according to the company.

Now entering its final stages, the pilot project will provide critical shutdown data to optimize the economic and environmental benefits, Nsolv says.

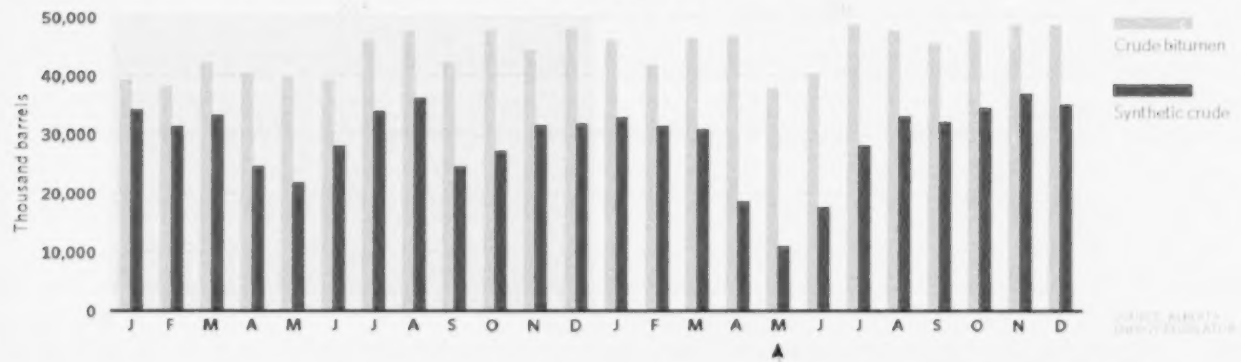
Launched in January 2014 near Fort McKay, Alta., the pilot project has produced more than 125,000 barrels of oil while using no water, recording no safety or environmental incidents and generating few greenhouse gas (GHG) emissions.

Compared to traditional extraction methods such as SAGD, Nsolv says its pilot demonstrates that at commercial-scale application, the technology can generate a higher return on investment due to lower capital and operating costs as well as producing a partially upgraded, higher-quality oil product at rates comparable with SAGD.

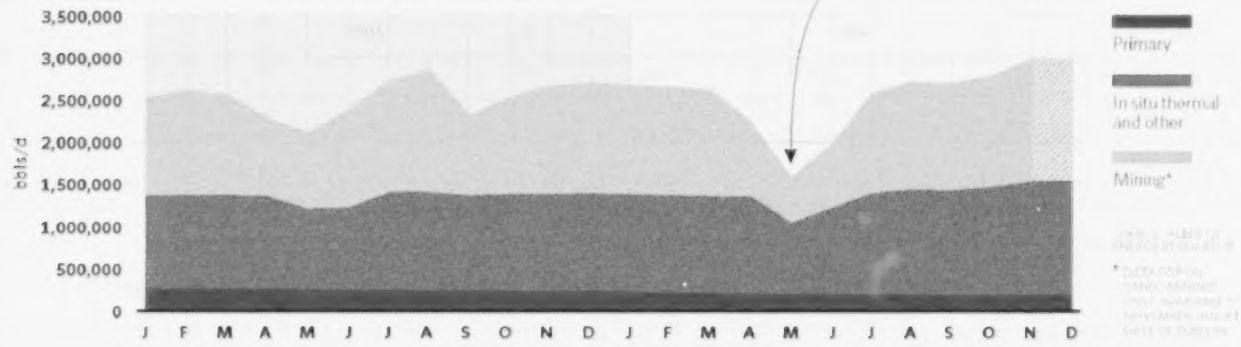
Additionally, the technology could provide access to otherwise inaccessible shallow resources and, because of the much lower GHG intensity, could allow up to 800,000 bbls/d of greater oil production under Alberta's 100-megatonne carbon cap, Nsolv says.

OIL SANDS DATA

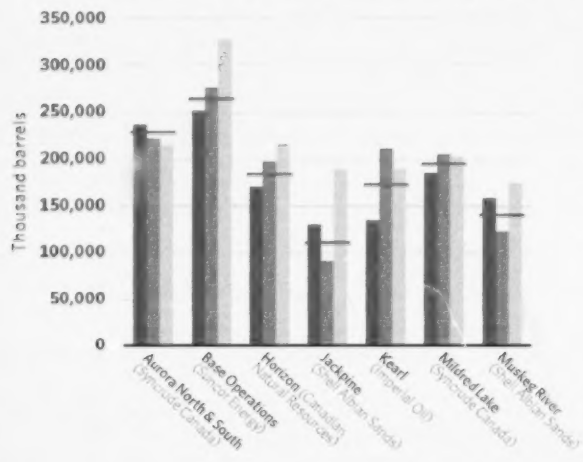
ALBERTA CRUDE BITUMEN AND SYNTHETIC CRUDE PRODUCTION


50,000
40,000
30,000
20,000
10,000
0
Thousand barrels
J F M A M J J A S O N D J F M A M J J A S O N D
Crude bitumen
Synthetic crude
May 2016 production drop due to Fort McMurray wildfires.

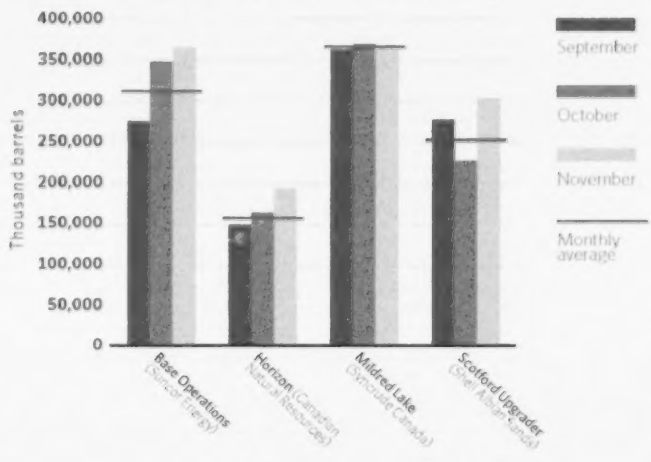
ALBERTA BITUMEN PRODUCTION BY EXTRACTION TYPE



OIL SANDS MINING PRODUCTION BY PROJECT 2016



OIL SANDS UPGRADER PRODUCTION BY PROJECT 2016



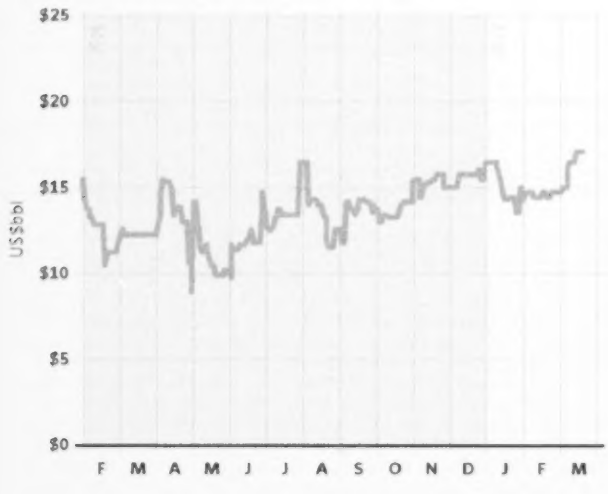
THERMAL OIL SANDS PRODUCTION BY PROJECT
OC. 2016 - DEC. 2016

(Barrels per day)

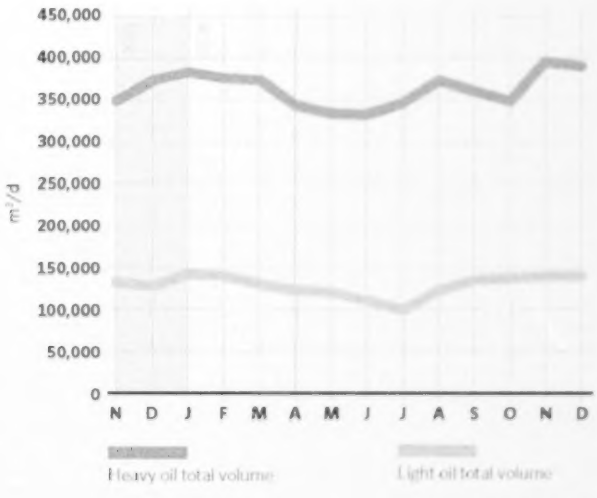
COMMERCIAL SCHEMES					
COMPANY	FIELD	OCT	NOV	DEC	MONTHLY AVERAGE
Suncor Energy Inc.	Firebag	207,880.8	205,665.5	201,160.7	204,902.3
Imperial Oil Limited	Cold Lake	156,531.4	161,014.1	159,114.0	158,886.5
Cenovus Energy Inc.	Christina Lake	132,474.7	178,707.4	184,648.1	165,276.7
Cenovus Energy Inc.	Foster Creek	155,715.6	166,324.6	166,151.0	162,730.4
Devon Canada Corporation	Jackfish	123,313.0	116,767.2	118,231.5	119,437.2
MEG Energy Corp.	Christina Lake	80,566.2	80,705.8	78,933.4	80,068.5
Canadian Natural Resources Limited	Primrose & Wolf Lake	81,578.2	90,151.9	90,039.3	87,256.4
ConocoPhillips Canada Limited	Surmont	96,563.7	100,001.7	108,257.1	101,607.5
Canadian Natural Resources Limited	Kirby South	39,945.3	39,425.8	38,679.2	39,350.1
Suncor Energy Inc.	Mackay River	33,788.2	34,040.5	33,936.0	33,921.6
Husky Energy Inc.	Sunrise	32,937.9	33,758.0	34,868.8	33,854.9
CNOOC Limited	Long Lake	33,874.4	33,466.2	36,374.0	34,571.5
Statoil	Leismer Demonstration	24,317.0	24,028.3	22,994.3	23,779.9
Husky Energy Inc.	Tucker	20,190.9	20,807.3	21,784.8	20,927.7
Pengrowth Energy Corporation	Lindbergh Pilot	15,376.7	15,433.3	15,189.3	15,333.1
Connacher Oil and Gas Limited	Great Divide	9,728.5	10,128.5	10,388.9	10,081.9
Athabasca Oil Corporation	Hangingstone	8,430.9	7,764.1	8,675.5	8,290.2
OSUM Oil Sands Corp.	Orion	8,297.5	8,038.4	7,968.6	8,101.5
Royal Dutch Shell plc	Peace River/Carmon Creek	5,431.3	5,260.8	5,170.2	5,287.4
BlackPearl Resources Inc.	Blackrod	542.8	503.8	520.8	522.5
Sunshine Oilsands Ltd.	West Ells	70.4	245.9	710.7	342.4
Penn West Petroleum Ltd.	Seal Main Pilot	79.9	71.1		50.3
Penn West Petroleum Ltd.	Harmon Valley South Pilot	101.9	112.6	47.8	87.4
Total Commercial		**1,267,737.1**	**1,332,422.8**	**1,343,843.9**	**1,314,667.9**

CRUDE OIL PRICE DIFFERENTIAL (WTI-WCS)

Recorded until March 13, 2017

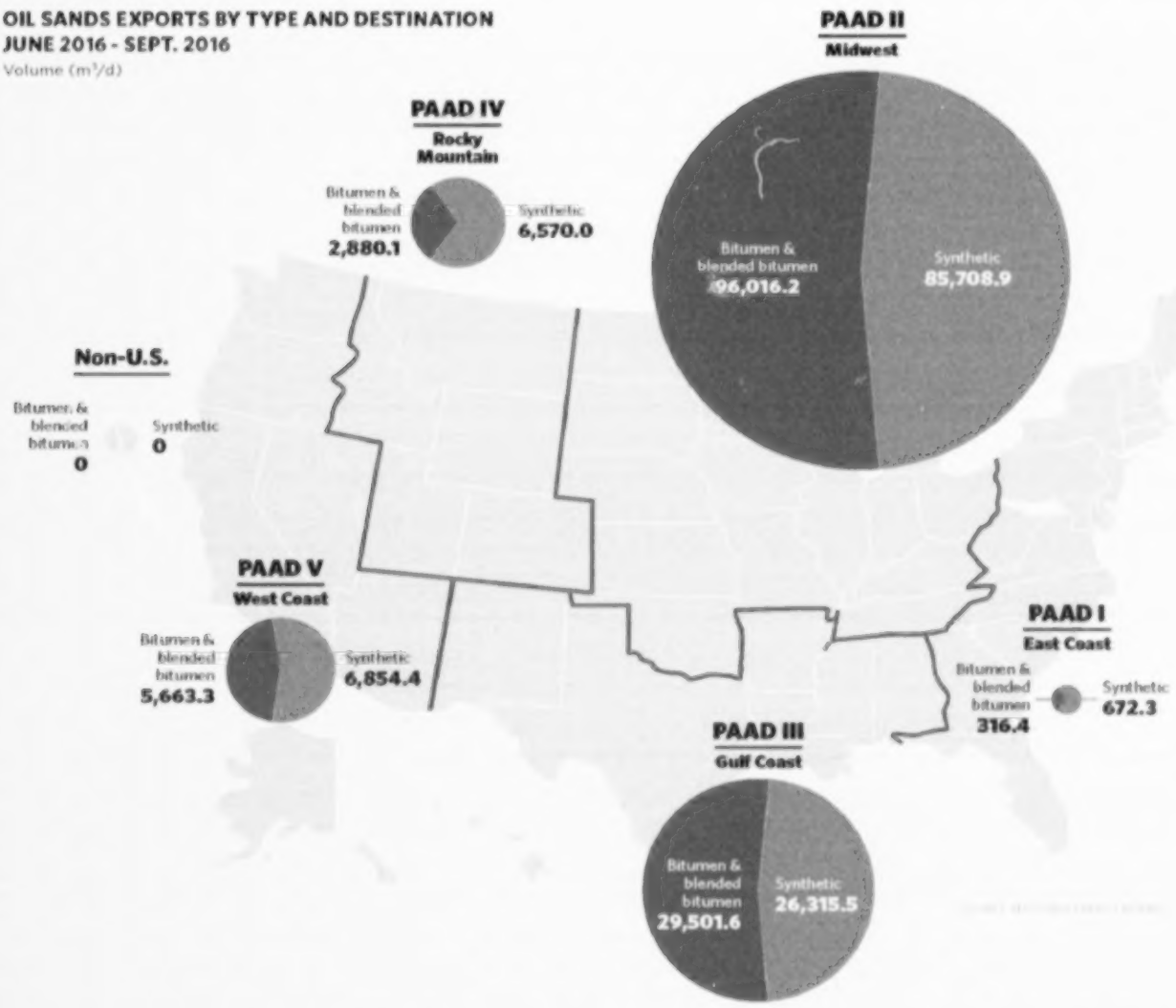


CANADIAN CRUDE OIL EXPORTS

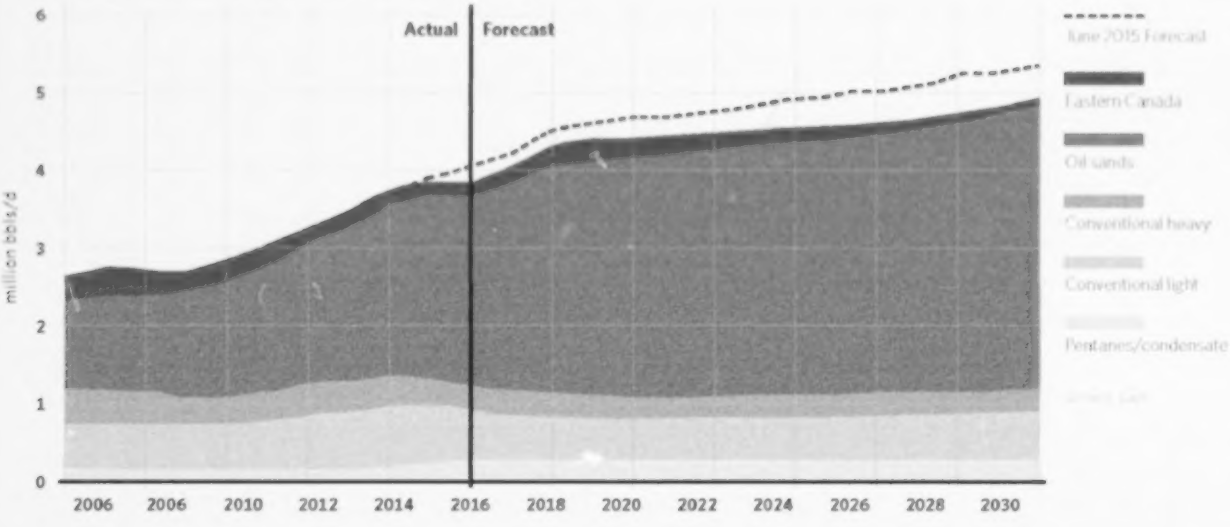


OIL SANDS EXPORTS BY TYPE AND DESTINATION
JUNE 2016 - SEPT. 2016

Volume (m^3/d)



CANADIAN OIL SANDS & CONVENTIONAL PRODUCTION



GLOSSARY OF OIL SANDS TERMS

A

ASPHALTENES

The heaviest and most concentrated aromatic hydrocarbon fractions of bitumen.

B

BARREL

The traditional measurement for crude oil volumes. One barrel equals 42 U.S. gallons or 159 litres. There are 6.29 barrels in one cubic metre of oil.

BITUMEN

Naturally occurring, viscous mixture of hydrocarbons that contains high levels of sulphur and nitrogen compounds. In its natural state, it is not recoverable at a commercial rate through a well because it is too thick to flow. Bitumen typically makes up about 10 per cent by weight of oil sand, but saturation varies.

C

COGENERATION

The simultaneous production of electricity and steam, which is part of the operations of many oil sands projects.

COKING

An upgrading/refining process used to convert the heaviest fraction of bitumen into lighter hydrocarbons by rejecting carbon as coke. Coking can be either delayed coking (semi-batch) or fluid coking (continuous).

CONDENSATE

Mixture of extremely light hydrocarbons recoverable from gas reservoirs. Condensate is also referred to as a natural gas liquid and is used as a diluent to reduce bitumen viscosity for pipeline transportation.

CONVENTIONAL CRUDE OIL

Mixture of mainly pentane and heavier hydrocarbons recoverable at a well from an underground reservoir and liquid at atmospheric pressure and temperature. Unlike bitumen, it flows through a well without stimulation and through a pipeline without processing or dilution.

CRACKING

An upgrading/refining process for converting large, heavy molecules into smaller ones. Cracking processes include fluid cracking and hydrocracking.

CYCLIC STEAM STIMULATION (CSS)

An in situ production method incorporating cycles of steam injection, steam soaking and oil production. The steam reduces the viscosity of the bitumen and allows it to flow to the production well.

D

DENSITY

The heaviness of crude oil, indicating the proportion of large, carbon-rich molecules, generally measured in kilograms per cubic metre (kg/m^3) or degrees on the American Petroleum Institute (API) gravity scale. In western Canada, oil up to 900 kg/m^3 is considered light-to-medium crude; oil above this density is deemed as heavy oil or bitumen.

DILBIT

Bitumen that has been reduced in viscosity through the addition of a diluent such as condensate or naphtha.

DILUENT

A light hydrocarbon blended with bitumen to enable pipeline transport. See Condensate.

E

EXTRACTION

A process unique to the oil sands industry that separates the bitumen from the oil sand using hot water, steam and caustic soda.

F

FROTH TREATMENT

The means to recover bitumen from the mixture of water, bitumen and solids "froth" produced in hot-water extraction (in mining-based recovery).

G

GASIFICATION

A process to partially oxidize any hydrocarbon, typically heavy residues, to a mixture of hydrogen and carbon monoxide. Can be used to produce hydrogen and various energy by-products.

GROUNDWATER

Water accumulations below the Earth's surface that supply fresh water to wells and springs.

H

HEAVY CRUDE OIL

Oil with a gravity below 22 degrees API. Heavy crudes must be blended or mixed with condensate to be shippe by pipeline.

HYDROCRACKING

Refining process for reducing heavy hydrocarbons into lighter fractions using hydrogen and a catalyst; can also be used in upgrading bitumen.

HYDROTRANSPORT

A slurry process that transports water and oil sand through a pipeline to primary separation vessels located in an extraction plant.

HYDROTREATER

An upgrading/refining process unit that reduces sulphur and nitrogen levels in crude oil fractions by catalytic addition of hydrogen.

I

IN SITU

A Latin phrase meaning "in its original place." In situ recovery refers to various drilling-based methods used to recover deeply buried bitumen deposits.

IN SITU COMBUSTION

An enhanced oil recovery method that works by generating combustion gases (primarily CO and CO_2) downhole, which then push the oil toward the recovery well.

L

LEASE

A legal document from the province of Alberta giving an operator the right to extract bitumen from the oil sand existing within the specified lease area. The land must be reclaimed and returned to the Crown at the end of operations.

LIGHT CRUDE OIL

Liquid petroleum with a gravity of 28 degrees API or higher. A high-quality light crude oil might have a gravity of about 40 degrees API. Upgraded crude oils from the oil sands run around 30–33 degrees API (compared to 32–34 for Light Arab and 37–40 for West Texas Intermediate).

M

MATURE FINE TAILINGS

A gel-like material resulting from the processing of clay fines contained within the oil sands.

O

OIL SANDS

Bitumen-soaked sand deposits located in three geographic regions of Alberta: Athabasca, Cold Lake and Peace River. The Athabasca deposit is the largest, encompassing more than 42,340 square kilometres. Total in-place deposits of bitumen in Alberta are estimated at 1.7 trillion to 2.5 trillion barrels.

OVERBURDEN

A layer of sand, gravel and shale between the surface and the underlying oil sand in the mineable oil sands region that must be removed before oil sands can be mined.

P

PERMEABILITY

The capacity of a substance, such as rock, to transmit a fluid, such as crude oil, natural gas or water. The degree of permeability depends on the number, size and shape of the pores and/or fractures in the rock and their interconnections. It is measured by the time it takes a fluid of standard viscosity to move a given distance. The unit of permeability is the Darcy.

PETROLEUM COKE

Solid, black hydrocarbon that is left as a residue after the more valuable hydrocarbons have been removed from the bitumen by heating the bitumen to high temperatures.

PRIMARY PRODUCTION

An in situ recovery method that uses natural reservoir energy (such as gas drive, water drive and gravity drainage) to displace hydrocarbons from the reservoir into the wellbore and up to the surface. Primary production uses an artificial lift system in order to reduce the bottomhole pressure or increase the differential pressure to sustain hydrocarbon recovery, since reservoir pressure decreases with production.

R

RECLAMATION

Returning disturbed land to a stable, biologically productive state. Reclaimed property is returned to the province of Alberta at the end of operations.

S

STEAM ASSISTED GRAVITY DRAINAGE (SAGD)

An in situ production process using two closely spaced horizontal wells: one for steam injection and the other for production of the bitumen/water emulsion.

SURFACE MINING

Operations to recover oil sands by open-pit mining using trucks and shovels. Less than 20 per cent of Alberta's oil sands resources are located close enough to the surface (within 75 metres) for mining to be economic.

SYNTHETIC CRUDE OIL

A manufactured crude oil comprised of naphtha, distillate and gas oil-boiling range material. Can range from high-quality, light, sweet bottomless crude to heavy, sour blends.

T

TAILINGS

A combination of water, sand, silt and fine clay particles that is a byproduct of removing the bitumen from the oil sand through the extraction process.

TAILINGS SETTLING BASIN

The primary purpose of the tailings settling basin is to serve as a process vessel, allowing time for tailings water to clarify and silt and clay particles to settle so that the water can be reused in extraction. The settling basin also acts as a thickener, preparing mature fine tails for final reclamation.

THERMAL RECOVERY

Any in situ process where heat energy (generally steam) is used to reduce the viscosity of bitumen to facilitate recovery.

U

UPGRADING

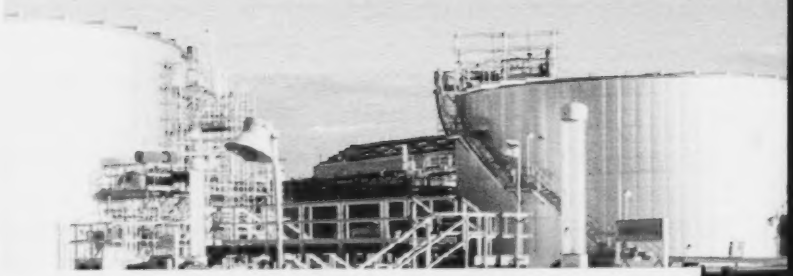
The process of converting heavy oil or bitumen into synthetic crude either through the removal of carbon (coking) or the addition of hydrogen (hydroconversion).

V

VISCOSITY

The ability of a liquid to flow. The lower the viscosity, the more easily the liquid will flow.

OIL SANDS CONTACTS



OIL SANDS PRODUCERS

Athabasca Oil www.atha.com
Baytex Energy www.baytex.ab.ca
BlackPearl Resources www.blackpearlresources.ca
Brion Energy www.brionenergy.com
Canadian Natural Resources www.cnrl.com
Cenovus Energy www.cenovus.com
Chevron Canada www.chevron.ca
CNOOC www.cnoocltd.com
Connacher Oil and Gas www.connacheroil.com
ConocoPhillips Canada www.conocophillips.ca
Devon Canada www.dvn.com
Enerplus Resources Fund www.enerplus.com
E-T Energy www.e-tenergy.com
Grizzly Oil Sands www.grizzlyoilsands.com
Harvest Operations www.harvestenergy.ca
Husky Energy www.huskyenergy.ca
Imperial Oil www.imperialoil.ca
Japan Canada Oil Sands www.jacos.com
Koch Exploration Canada www.kochexploration.ca
Korea National Oil www.knoc.co.kr
Laricina Energy www.laricinaenergy.com
Marathon Oil www.marathon.com
MEG Energy www.megenergy.com
Nexen www.nexeninc.com
North West Upgrading www.northwestupgrading.com
Nsolv www.nsolv.ca
Oak Point Energy www.oakpointenergy.ca
Occidental Petroleum www.oxy.com
Osum Oil Sands www.osumcorp.com
Pan Orient Energy www.panorient.ca
Paramount Resources www.paramountres.com
Pengrowth Energy www.pengrowth.com
PetroChina www.petrochina.com.cn/ptr
PTT Exploration and Production www.pttep.com
Shell Canada www.shell.ca
Sinopec www.sinopecgroup.com/group/en
Statoil Canada www.statoil.com
Suncor Energy www.suncor.com
Sunshine Oilsands www.sunshineoilsands.com
Syncrude www.syncrude.ca
Teck Resources www.teck.com
Total E&P Canada www.total-ep-canada.com
Touchstone Exploration www.touchstoneexploration.com
Value Creation Group www.vctek.com

ASSOCIATIONS/ORGANIZATIONS

Alberta Chamber of Resources www.acr-alberta.com
Alberta Chambers of Commerce www.abchamber.ca
Alberta Energy www.energy.gov.ab.ca
Alberta Energy Regulator www.aer.ca
Alberta Environment and Parks www.aep.alberta.ca
Alberta Innovates www.albertainnovates.ca
Alberta Innovation and Advanced Education www.eae.alberta.ca
Alberta's Industrial Heartland Association www.industrialheartland.com
Building Trades of Alberta www.bta.ca
Canada's Oil Sands Innovation Alliance www.cosia.ca
Canadian Association of Geophysical Contractors www.cagc.ca
Canadian Association of Petroleum Producers www.capp.ca
Canadian Heavy Oil Association www.choa.ab.ca
In Situ Oil Sands Alliance www.iosa.ca
Lakeland Industry & Community Association www.lica.ca
Natural Resources Conservation Board www.nrcb.ca
Oil Sands Community Alliance www.oscaalberta.ca
Oil Sands Secretariat www.energy.alberta.ca
Petroleum Technology Alliance Canada www.ptac.org

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